

TMDLs 101

Tennessee Process for Developing EPA-Approved TMDLs

Harpeth River Watershed TMDL Stakeholder Meeting

November 7, 2018

Dennis Borders

TDEC, Division of Water Resources



REGULATORY REQUIREMENTS

- CWA: Established the requirement for TMDLs:
to restore and maintain the chemical, physical, and biological integrity of the Nation's waters
- 40 CFR 130.7: Sets the process and requirements for states to follow.

What is a TMDL?

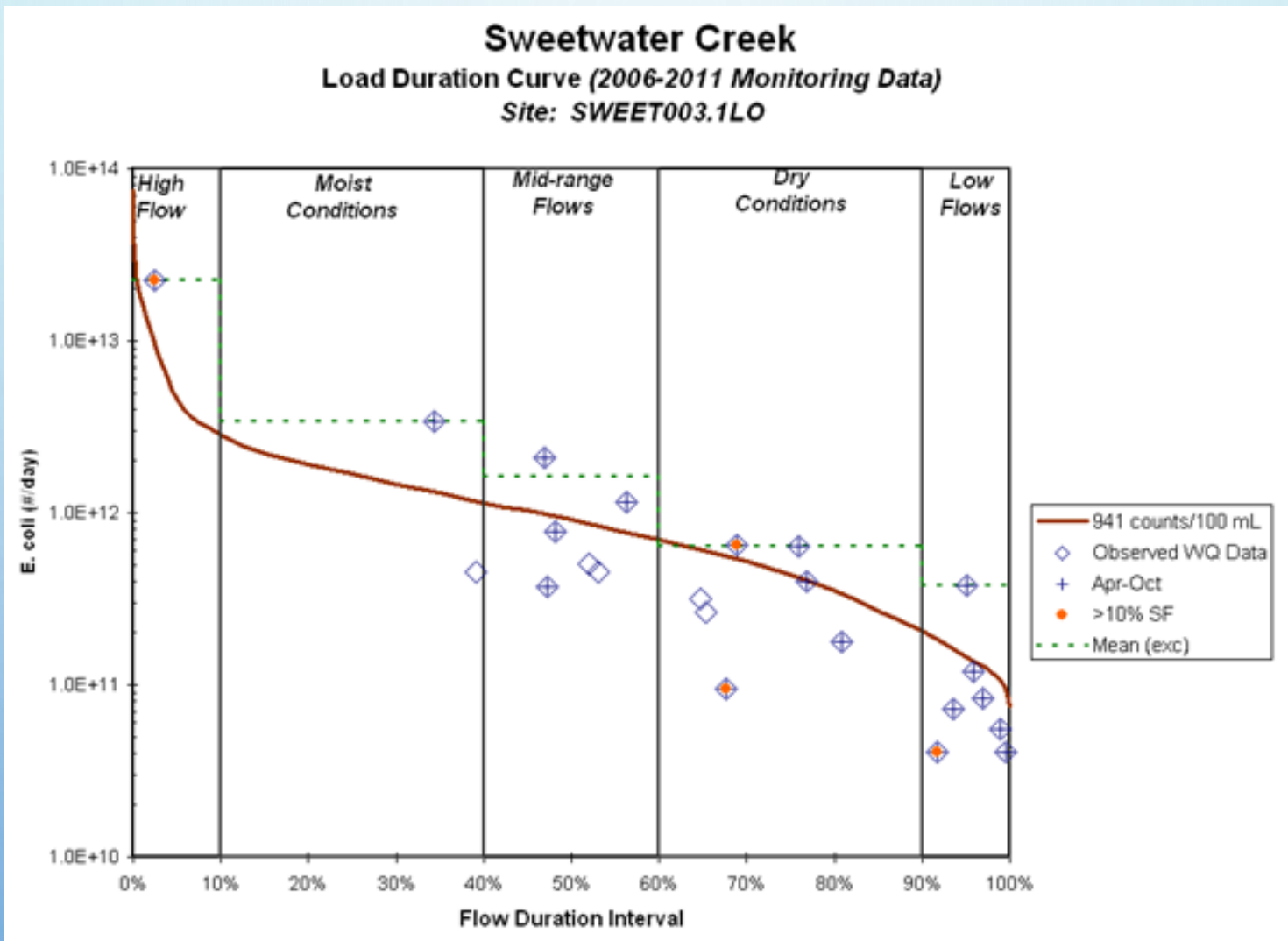
- TMDL stands for: Total Maximum Daily Load
A calculation of the maximum amount of a pollutant that a waterbody can receive and still achieve water quality standards
- TMDL is the pollutant load from point sources (WLA) + pollutant load from nonpoint sources (LA) + margin of safety (MOS)

$$\text{TMDL} = \sum \text{WLA} + \sum \text{LA} + \text{MOS}$$

What is a TMDL?

- Each pollutant must have a separate TMDL calculated for it, therefore there can be multiple TMDLs for a waterbody
- The TMDL comes in the form of a technical document or plan
- TMDLs can be simple (e.g., mass balance) or complex (e.g., dynamic model)

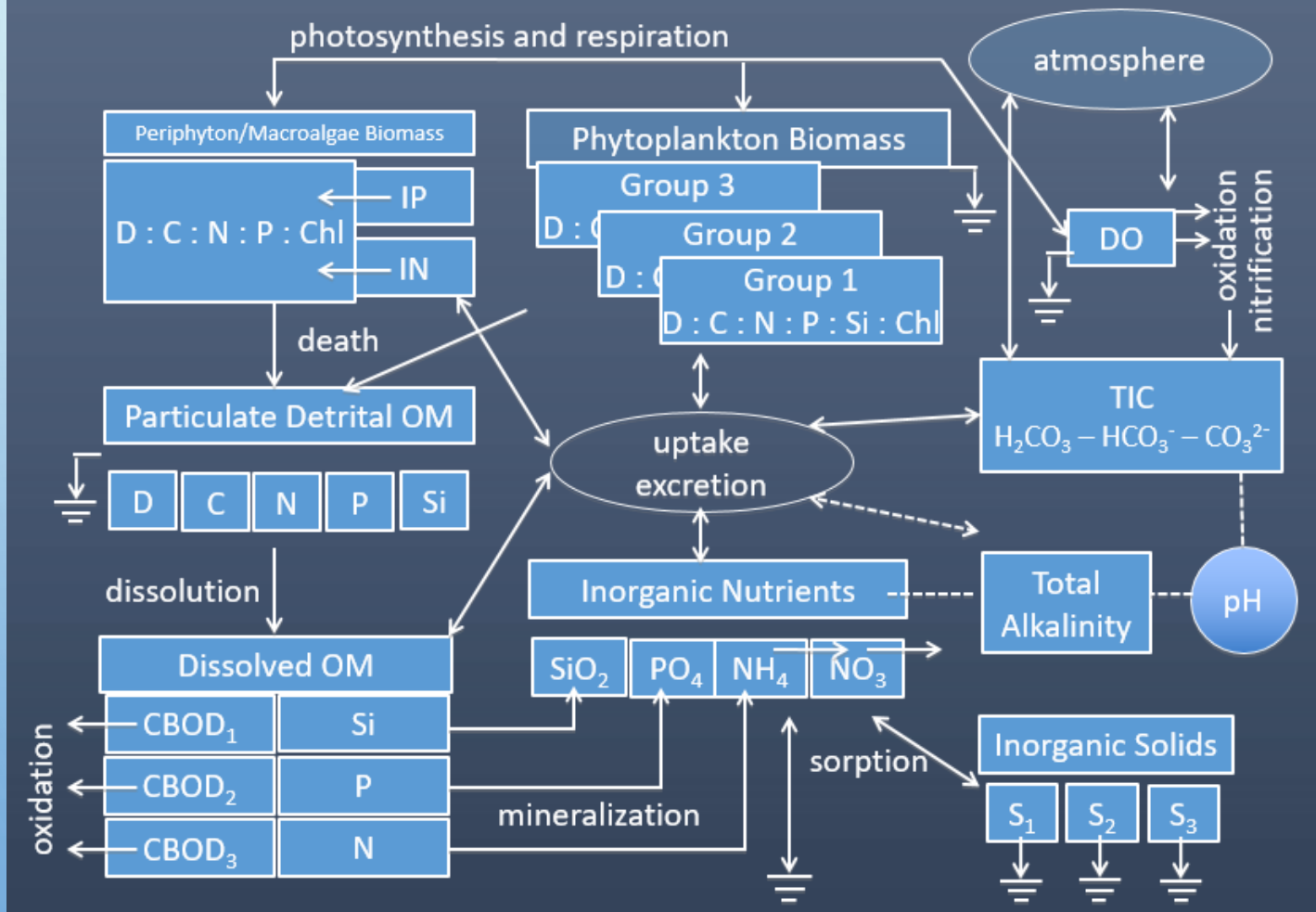
What is a TMDL?



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EPA's WASP8 Advanced Eutrophication Module:

Variables and Processes



Elements of a Typical TMDL Document

- Identification of Waterbody, Pollutant of Concern, and Pollutant Sources

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* Required by 40 CFR Part 130

Identification of Waterbody, Pollutant of Concern, and Pollutant Sources

- The TMDL must identify the waterbody as it appears on the State 303(d) List, including the pollutant of concern. The TMDL submittal must include a description of point and nonpoint sources (EPA Decision Document).

Identification of Waterbody, Pollutant of Concern, and Pollutant Sources

Table 3. Extract from Draft 2018 List Impaired and Threatened Waters – Holston River Watershed

Waterbody ID	Impacted Waterbody	Miles/Acres Impaired	Cause (Pollutant)	Pollutant Source
TN06010104001_0100	Love Creek	9.7	Escherichia coli	Discharges from MS4 Area
TN06010104001_0500 ^a	Roseberry Creek	20.0	Escherichia coli	Pasture Grazing Septic Tanks
TN06010104001_0800 ^a	Lost Creek	26.8	Escherichia coli	Pasture Grazing Septic Tanks
TN06010104001_0900 ^a	Beaver Creek	21.0	Escherichia coli	Pasture Grazing
TN06010104001_1400 ^a	Swanpond Creek	16.3	Escherichia coli	Discharges from MS4 Area

Identification of Waterbody, Pollutant of Concern, and Pollutant Sources

7.0 SOURCE ASSESSMENT

An important part of TMDL analysis is the identification of individual sources, or source categories of pollutants in the watershed that affect E. coli loading and the amount of loading contributed by each of these sources.

Under the Clean Water Act, sources are classified as either point or nonpoint sources. Under 40 CFR §122.2, (<http://www.gpo.gov/fdsys/pkg/CFR-2011-title40-vol22/pdf/CFR-2011-title40-vol22-sec122-2.pdf>), a point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. The National Pollutant Discharge Elimination System (NPDES) program (<https://www.epa.gov/npdes/>) regulates point source discharges.

Nonpoint sources are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. For the purposes of this TMDL, all sources of pollutant loading not regulated by NPDES permits are considered nonpoint sources. The TMDL must provide a Load Allocation (LA) for these sources.

Identification of Waterbody, Pollutant of Concern, and Pollutant Sources

7.0 Source Assessment

7.1 Point Sources

7.1.1 NPDES Regulated Municipal and Industrial
Wastewater Treatment Facilities

7.1.2 NPDES Regulated Municipal Separate Storm
Sewer Systems (MS4s)

7.1.3 NPDES Regulated Industrial Stormwater

7.1.4 NPDES Concentrated Animal Feeding Operations
(CAFOs)

7.2 Nonpoint Sources

7.2.1 Wildlife

7.2.2 Agricultural Animals

7.2.3 Failing Septic Systems

7.2.4 Urban Development

APPLICABLE WATER QUALITY STANDARDS & NUMERIC WATER QUALITY TARGET

- TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numeric WQS (40 CFR Part 130.7).

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- The TMDL must include a description of the applicable WQS, including the designated uses and the applicable numeric or narrative water quality criterion. A numeric water quality target for the TMDL (a quantitative value used to measure whether or not the applicable WQS is attained) must be identified (EPA Decision Document).

APPLICABLE WATER QUALITY STANDARDS & NUMERIC WATER QUALITY TARGET

Designated Uses:

The designated use classifications for all waterbodies in the Holston River watershed include fish and aquatic life, irrigation, livestock watering & wildlife, and recreation.

APPLICABLE WATER QUALITY STANDARDS & NUMERIC WATER QUALITY TARGET

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Waterbody ID	Waterbody Name	Portion	Designated Use
TN06010104004T_1900	Fall Creek	RM 0.0 to RM 1.0	Domestic Water Supply Industrial Water Supply
TN06010104004T_2300	Turkey Creek	RM 0.0 to RM 1.2	Domestic Water Supply Industrial Water Supply
TN06010104004T_2600	Mossy Creek	RM 0.0 to RM3.9	Domestic Water Supply Industrial Water Supply
		RM 3.9 to Origin	Industrial Water Supply Trout Stream
TN06010104011_0600	Bradley Creek	RM 0.0 to Origin	Domestic Water Supply

APPLICABLE WATER QUALITY STANDARDS & NUMERIC WATER QUALITY TARGET

Example: E.
coli (Numeric
WQC =
Target)

Water Quality Targets:

Derived from *State of Tennessee Water Quality Standards, Chapter 0400-40-03, General Water Quality Criteria, 2015 Version* (TDEC, 2015) for recreation use classification (most stringent):

The concentration of the E. coli group shall not exceed 126 colony forming units per 100 mL, as a geometric mean based on a minimum of 5 samples collected from a given sampling site over a period of not more than 30 consecutive days with individual samples being collected at intervals of not less than 12 hours. For the purposes of determining the geometric mean, individual samples having an E. coli concentration of less than 1 per 100 mL shall be considered as having a concentration of 1 per 100 mL.

Additionally, the concentration of the E. coli group in any individual sample taken from a lake, reservoir, State Scenic River, Exceptional Tennessee Water or ONRW (0400-40-03-.06) shall not exceed 487 colony forming units per 100 mL. The concentration of the E. coli group in any individual sample taken from any other waterbody shall not exceed 941 colony forming units per 100 mL.

APPLICABLE WATER QUALITY STANDARDS & NUMERIC WATER QUALITY TARGET

Example:
Siltation
(Narrative
WQC)

Water Quality Targets (Siltation):

Derived from *State of Tennessee Water Quality Standards, Chapter 0400-04-03, General Water Quality Criteria* (TDEC, 2015a); most stringent narrative criteria applicable to fish & aquatic life use classification:

Biological Integrity:

The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or, in the case of wadeable streams, substantially different from conditions in reference streams in the same ecoregion. The parameters associated with this criterion are the aquatic biota measured. These are response variables.

APPLICABLE WATER QUALITY STANDARDS & NUMERIC WATER QUALITY TARGET

Example:
Siltation
(Narrative
WQC)
(Cont.)

Interpretation of this provision for all other wadeable streams, lakes, and reservoirs may be made using Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (EPA/841-B-99-002) or Lake and Reservoir Bioassessment and Biocriteria (EPA 841-B-98-007), and/or other scientifically defensible methods. Interpretation of this provision for wetlands or large rivers may be made using scientifically defensible methods. **Effects to biological populations will be measured by comparisons to upstream conditions or to appropriately selected reference sites in the same bioregion** if upstream conditions are determined to be degraded.

APPLICABLE WATER QUALITY STANDARDS & NUMERIC WATER QUALITY TARGET

Habitat: The quality of stream habitat shall provide for the development of a diverse aquatic community that meets regionally-based biological integrity goals. Examples of parameters associated with this criterion include but are not limited to: sediment deposition, embeddedness of riffles, velocity/depth regime, bank stability, and vegetative protection. Types of activities or conditions which can cause habitat loss include, but are not limited to: channel and substrate alterations, rock and gravel removal, stream flow changes, accumulation of silt, precipitation of metals, and removal of riparian vegetation. For wadeable streams, the in stream habitat within each subecoregion shall be generally similar to that found at reference streams. However, streams shall not be assessed as impacted by habitat loss if it has been demonstrated that the biological integrity goal has been met.

APPLICABLE WATER QUALITY STANDARDS & NUMERIC WATER QUALITY TARGET

Numeric Expression of Siltation Target:

- Target sediment loads (lbs/acre/year) are equal to average annual instream sediment loads from biologically healthy watersheds (Level IV Ecoregion reference sites).
- TMDLs are expressed as the percent reduction in average annual sediment load required for a subwatershed relative to the appropriate reference target load.

APPLICABLE WATER QUALITY STANDARDS & NUMERIC WATER QUALITY TARGET

Example:
Nutrients
(Narrative
WQC)

- (k) **Nutrients** - The waters shall not contain nutrients in concentrations that stimulate aquatic plant and/or algae growth to the extent that aquatic habitat is substantially reduced and/or the biological integrity fails to meet regional goals. Additionally, the quality of downstream waters shall not be detrimentally affected. Examples of parameters associated with the criterion include but are not limited to: nitrogen, phosphorus, potassium, calcium, magnesium, and various forms of each.

APPLICABLE WATER QUALITY STANDARDS & NUMERIC WATER QUALITY TARGET

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- Numeric Expression of Nutrients Target?

Chlorophyll – a

Phosphorus, Nitrogen

DO

Other?



LOADING CAPACITY

- Loading Capacity: The greatest amount of loading that a water can receive without violating (exceeding) WQS. (40 CFR Part 130.2)

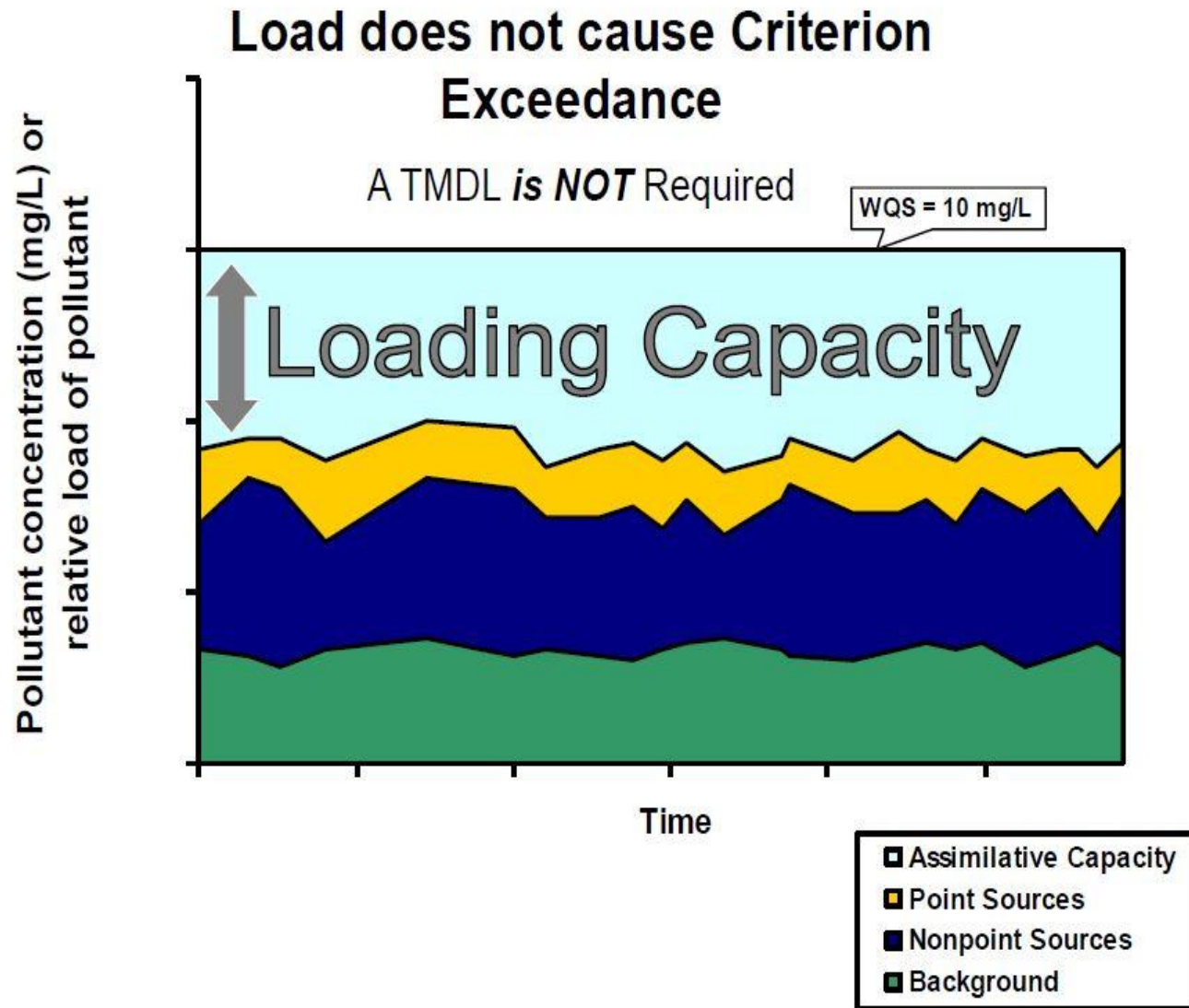
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- The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target, also known as loading capacity or assimilative capacity.

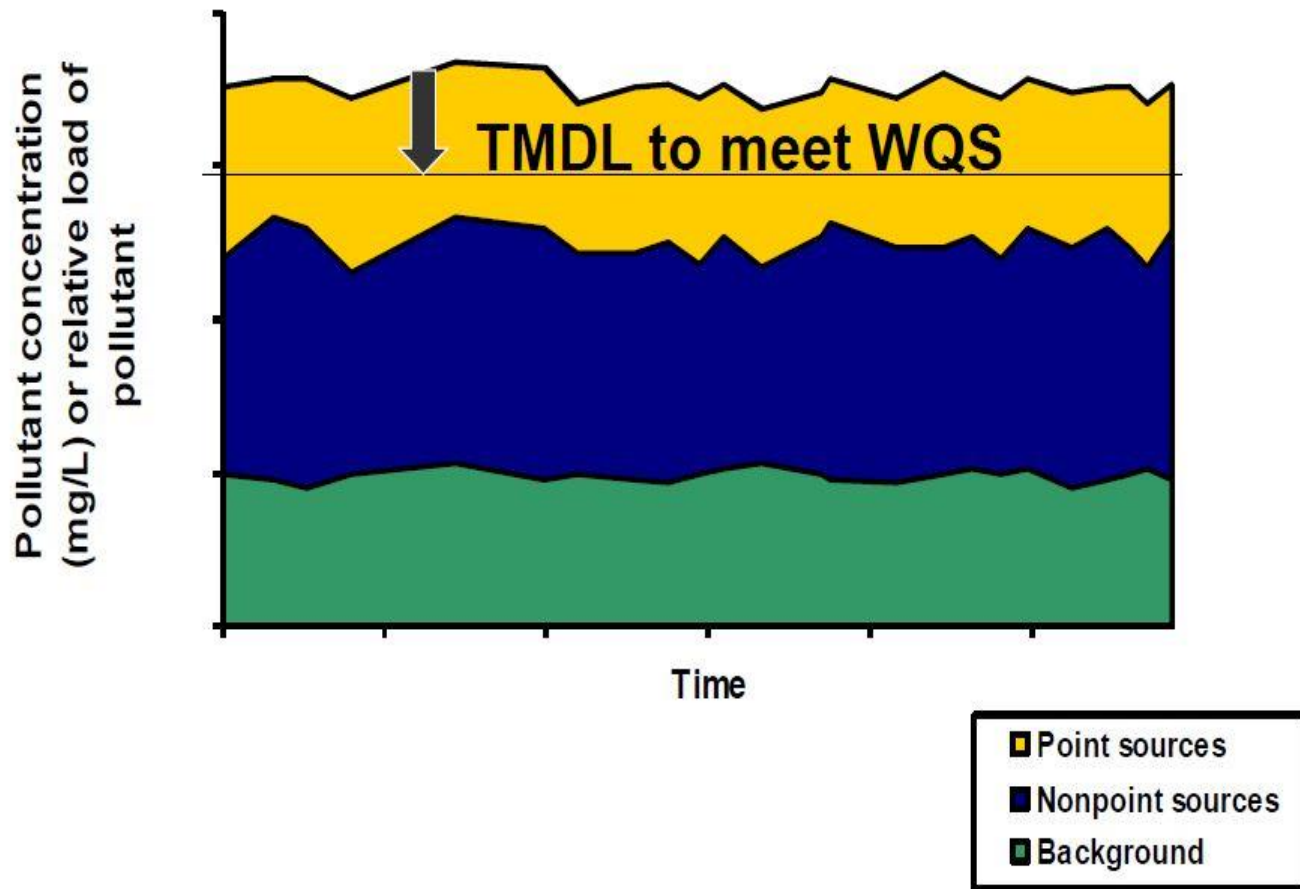
LOADING CAPACITY



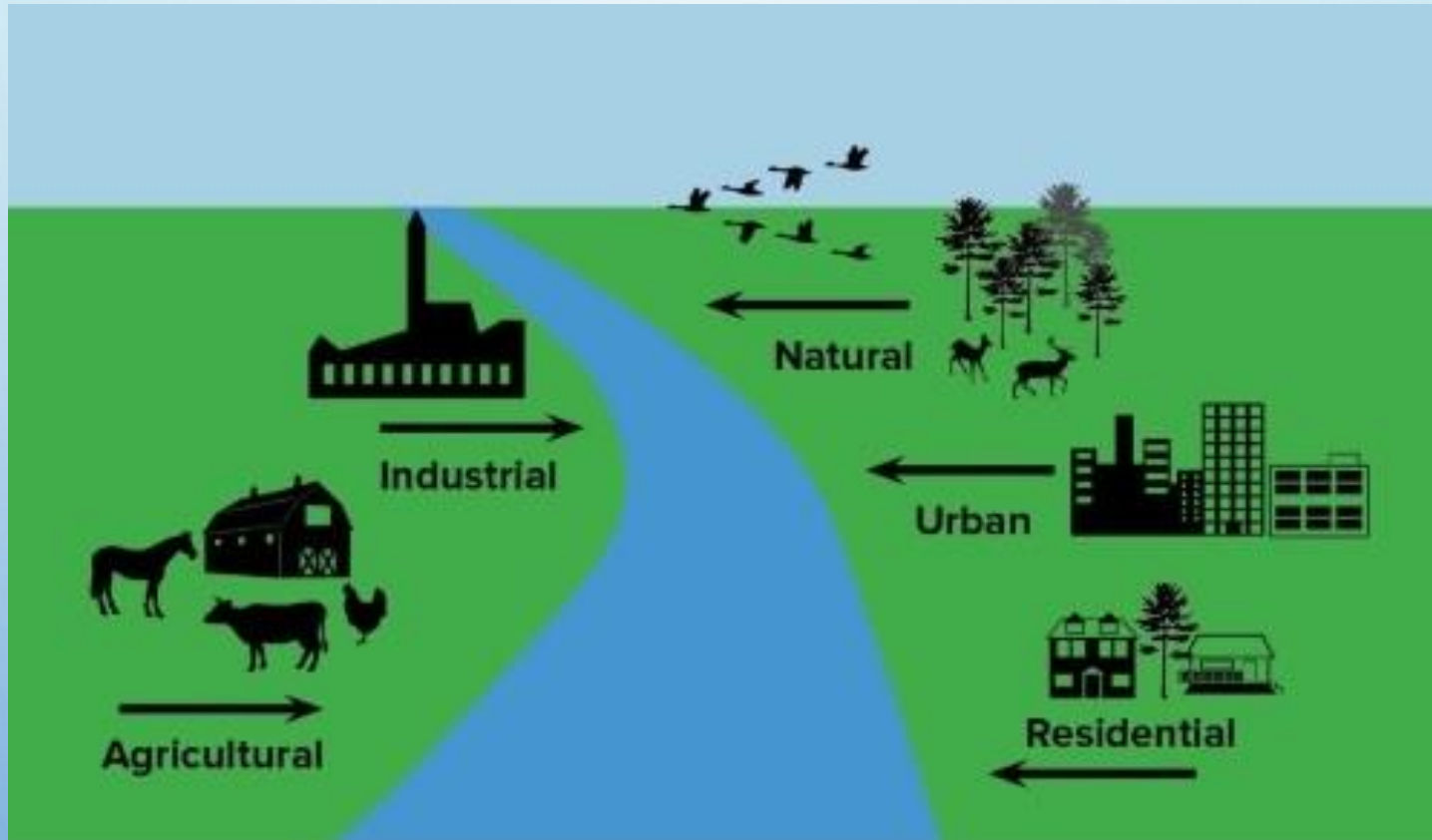
LOADING CAPACITY

No Remaining Loading Capacity

Need a TMDL to Meet WQS



LOAD ALLOCATIONS & WASTELOAD ALLOCATIONS



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- The MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS (EPA Decision Document).

MARGIN OF SAFETY

In Tennessee TMDLs:

Explicit (typical): $MOS = 10\%$ of TMDL

Example: Holston River Watershed E. coli TMDL

$$TMDL \text{ (CFU/day)} = 2.3 \times 10^{10} \times Q \text{ (in cfs)}$$

$$MOS \text{ (CFU/day)} = 2.3 \times 10^9 \times Q \text{ (in cfs)}$$

Implicit (typical):

10-yr continuous simulations incorporating a wide range of meteorological events

Point source loads based on design flow and permit limits

Target based on reference streams (best in region); lower than needed

Development of TMDL under critical conditions, including critical low flows (e.g., $7Q_{10}$)

TMDL EXPRESSION

Basic: $TMDL = \sum WLA + \sum LA + MOS$

E. Coli Example:

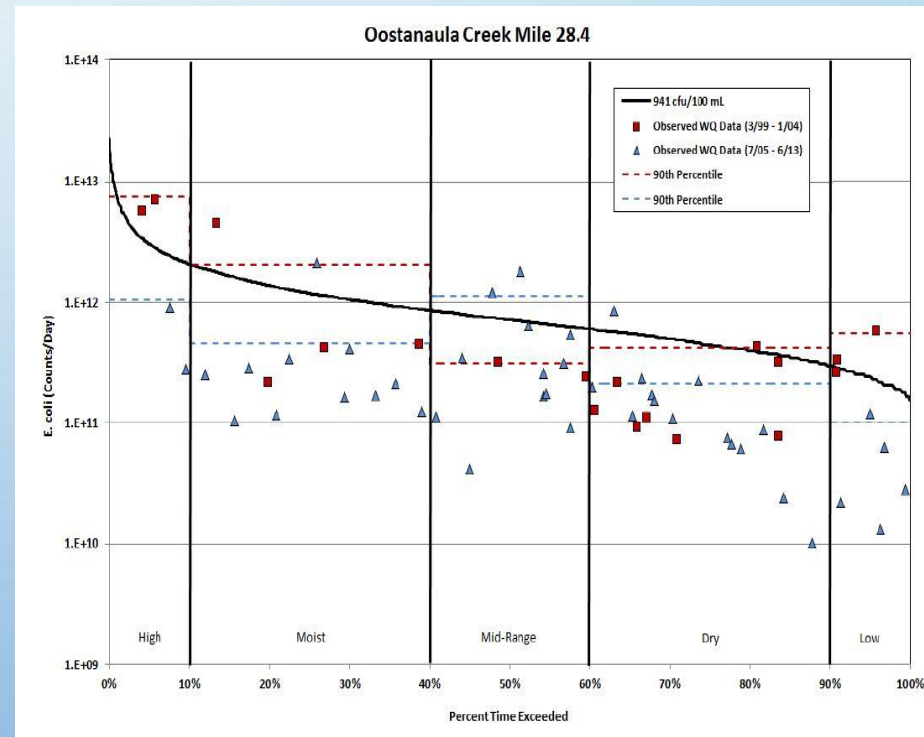
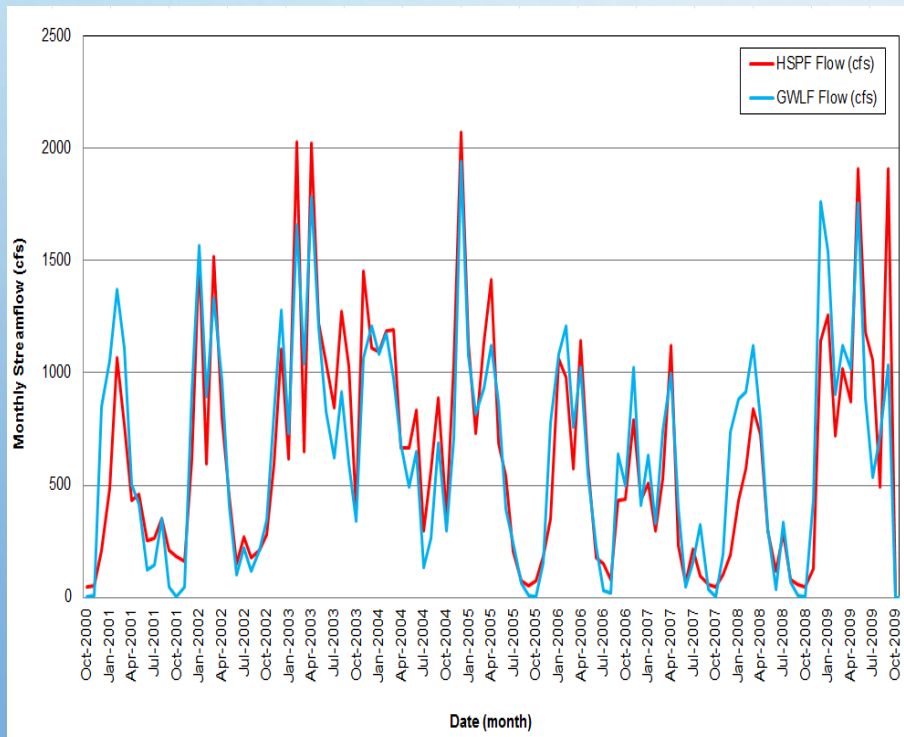
$$TMDL = WLA(WWTP) + WLA(Ind. SW) + WLA(MS4) + WLA(CAFO) + LA(DS) + LA(SW) + MOS$$

Sediment Example:

$$TMDL = WLA(RMCF) + WLA(TMSP) + WLA(Mining) + WLA(CSW) + WLA(MS4) + LA(NPS) + FG + MOS$$

CONSIDERATION OF SEASONAL VARIATION

- TMDLs shall be established... with seasonal variations (40 CFR Part 130.7 and EPA Decision Document).



MONITORING PLAN TO TRACK TMDL EFFECTIVENESS

- EPA's *Guidance for Water Quality-Based Decisions: The TMDL Process* (EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources (EPA Decision Document).

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- Not a required element of EPA's TMDL approval process, TDEC typically provides recommended monitoring to evaluate the progress toward attainment of WQS.

MONITORING PLAN TO TRACK TMDL EFFECTIVENESS

Example E. coli Monitoring Recommendations:

Future activities recommended for the Holston River watershed:

- Evaluate the effectiveness of implementation measures (see Sect. 9.6) and include BMP performance analysis and monitoring by permittees and stakeholders.
- Provide additional data to clarify status of ambiguous sites (e.g., geometric mean data) for potential listing as an impaired water.
- Continue ambient (long-term) monitoring at appropriate sites and key locations.

Comprehensive water quality monitoring activities include sampling during all seasons and a broad range of flow and meteorological conditions.

MONITORING PLAN TO TRACK TMDL EFFECTIVENESS

Example Sediment Monitoring Recommendations:

Evaluation of the effectiveness of TMDL implementation strategies should be conducted on multiple levels, as appropriate:

- Waterbody drainage area (i.e., TMDL analysis location)

- Subwatersheds or intermediate sampling locations

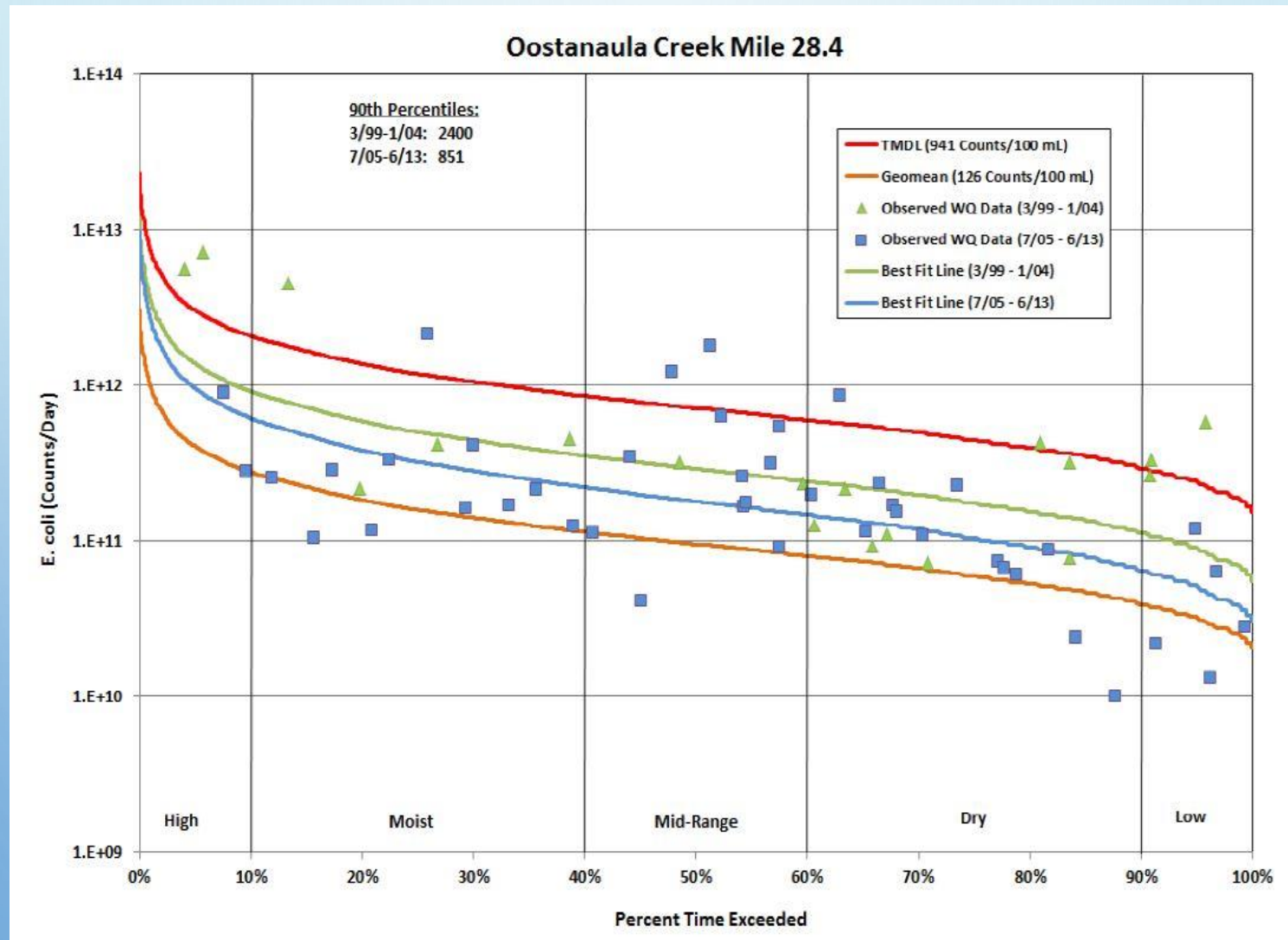
- Specific landuse areas (urban, pasture, etc.)

- Specific facilities (Mining, TMSP, RMCF, uniquely identified portion of MS4, etc.)

- Individual BMPs

In order to conduct an implementation effectiveness analysis on measures to reduce sediment source loading, monitoring results should be evaluated in one of several ways. Sampling results can be compared to water quality standards (e.g., biological integrity goals) for determination of impairment status, results can be compared on a before and after basis (temporal), or ...

MONITORING PLAN TO TRACK TMDL EFFECTIVENESS



IMPLEMENTATION PLAN

- EPA Memorandum, *New Policies for Establishing and Implementing Total Maximum Daily Loads*, directs EPA to assist states in developing implementation plans that include reasonable assurances that the NPS LAs will be achieved. Although implementation plans are not approved by EPA, they help establish the basis for EPA's approval of TMDLs (EPA Decision Document).

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- Not a required element of EPA's TMDL approval process, TDEC typically provides implementation guidance that requires an entire section of the TMDL report to describe.
- TDEC has no regulatory authority over most NPS discharges. Voluntary, incentive-based mechanisms will be used to implement NPS management measures in order to assure that measurable reductions to pollutant loadings can be achieved.

IMPLEMENTATION PLAN

- Local citizen-led and implemented management measures have the potential to provide the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources.

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- WLAs are generally implemented through EPA's NPDES program (permits) under CWA Section 402.

IMPLEMENTATION PLAN

Table 12. Example Agricultural Area Management Practice/Hydrologic Flow Zone Considerations

Flow Condition	High	Moist	Mid-range	Dry	Low
% Time Flow Exceeded	0-10	10-40	40-60	60-90	90-100
Grazing Management					
Prescribed Grazing (528A)	H	H	M	L	
Pasture & Hayland Mgmt (510)	H	H	M	L	
Deferred Grazing (352)	H	H	M	L	
Planned Grazing System (556)	H	H	M	L	
Proper Grazing Use (528)	H	H	M	L	
Proper Woodland Grazing (530)	H	H	M	L	
Livestock Access Limitation					
Livestock Exclusion (472)			M	H	H
Fencing (382)			M	H	H
Stream Crossing			M	H	H
Alternate Water Supply					
Pipeline (516)			M	H	H
Pond (378)			M	H	H
Trough or Tank (614)			M	H	H
Well (642)			M	H	H
Spring Development (574)			M	H	H
Manure Management					
Managing Barnyards	H	H	M	L	
Manure Transfer (634)	H	H	M	L	
Land Application of Manure	H	H	M	L	
Composting Facility (317)	H	H	M	L	

Example: E. coli
Implementation

IMPLEMENTATION PLAN

Table 11. Example Urban Area Management Practice/Hydrologic Flow Zone Considerations

Management Practice	Duration Curve Zone (Flow Zone)				
	High	Moist	Mid-Range	Dry	Low
Bacteria source reduction					
Remove illicit discharges			L	M	H
Address pet & wildlife waste		H	M	M	L
Combined sewer overflow management					
Combined sewer separation		H	M	L	
CSO prevention practices		H	M	L	
Sanitary sewer system					
Infiltration/inflow mitigation	H	M	L	L	
Inspection, maintenance, and repair		L	M	H	H
SSO repair/abatement	H	M	L		
Illegal cross-connections					
Septic system management					
Managing private systems		L	M	H	M
Replacing failed systems		L	M	H	M
Installing public sewers		L	M	H	M
Storm water infiltration/retention					
Infiltration basin		L	M	H	
Infiltration trench		L	M	H	
Infiltration/Biofilter swale		L	M	H	
Storm Water detention					
Created wetland		H	M	L	

Example: E. coli
Implementation
(Cont.)

IMPLEMENTATION PLAN

Example: Siltation Implementation

Table H-1. Best Management Practices Selection Matrix.

Management Practice	Type of Treatment		Applicability			
	Erosion Prevention	Sediment Control	Urban	Agricultural	Streambank & Channel	Roads and Highways
Recharge/Infiltration Practices						
Infiltration Trench		•	•			
Infiltration Basin		•	•			
Infiltration Swale		•	•			
Surface Sand Filter		•	•			
Low Impact Development Practices						
Minimize Disturbance Area	•		•	•		
Minimize Site Imperviousness	•		•			
Porous Pavement	•		•			•
Green Roof	•		•			
Bioretention	•		•			•
Rain Garden	•		•			
Preserve Infiltratable Soils	•		•	•		
Rain Barrels/Cisterns	•		•			

REASONABLE ASSURANCES

- In a water impaired by both point and nonpoint sources, where a point source is given a less stringent WLA based on an assumption that NPS load reductions will occur, reasonable assurance that the NPS reductions will happen must be explained in order for the TMDL to be approvable (EPA Decision Document).

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- Where a TMDL is developed for waters impaired by both point and nonpoint sources, determinations of reasonable assurance that the TMDL's LAs will be achieved could include whether practices capable of reducing the specified pollutant load: 1) exist; 2) are technically feasible at a level required to meet LAs; and 3) have a high likelihood of implementation.

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- The principal policy tools available to address NPS are voluntary and incentive-based programs, including grants and funding through CWA section 319, which addresses NPS through state-run nonpoint pollution management programs.

PUBLIC PARTICIPATION

- TMDLs shall be established for all pollutants preventing or expected to prevent attainment of WQS. Calculations to establish TMDLs shall be subject to public review as defined in the State CPP (40 CFR Part 130.7).

PUBLIC PARTICIPATION

- TMDLs shall be established for all pollutants preventing or expected to prevent attainment of WQS. Calculations to establish TMDLs shall be subject to public review as defined in the State CPP (40 CFR Part 130.7).
- EPA policy is that there must be full and meaningful public participation in the TMDL development process. Final TMDLs submitted to EPA for review and approval must describe the State's public participation process, including a summary of significant comments and the State's responses to those comments (EPA Decision Document).

PUBLIC PARTICIPATION

10.0 PUBLIC PARTICIPATION

In accordance with 40 CFR §130.7, the proposed E. coli TMDLs for the Upper Duck River watershed will be placed on Public Notice for a 35-day period and comments solicited. Steps that were taken in this regard include:

Example
(typical):

- 1) Notice of the proposed TMDLs was posted on the Tennessee Department of Environment and Conservation website. The announcement invited public and stakeholder comment and provided a link to a downloadable version of the TMDL document.
- 2) Notice of the availability of the proposed TMDLs (similar to the website announcement) was included in one of the NPDES permit Public Notice mailings which is sent to over 190 interested persons or groups who have requested this information.
- 3) Notice of the proposed TMDLs was posted on the DWR Facebook page. The announcement invited public and stakeholder comment and provided a link to a downloadable version of the TMDL document.
- 4) Letters were sent via email to WWTPs and other facilities located in E. coli-impaired subwatersheds or drainage areas in the Upper Duck River watershed, permitted to discharge treated effluent containing E. coli, advising them of the proposed TMDLs and their availability on the TDEC website and providing a link to a downloadable version of the TMDL document. The letters also stated that a copy of the draft TMDL document would be provided on request. Letters were sent to the following facilities:

Bell Buckle STP (TN0020591)
Manchester STP (TN0025038)
Shelbyville STP (TN0024180)
Tyson Foods, Inc. (TN0002135)
Wartrace STP (TN0020443)

PUBLIC PARTICIPATION

Example
(typical)
(Cont.):

- 5) Letters were sent via email to those MS4s that are wholly or partially located in E. coli-impaired subwatersheds, advising them of the proposed TMDLs and their availability on the TDEC website and providing a link to a downloadable version of the TMDL document. The letters also stated that a copy of the draft TMDL document would be provided on request. Letters were sent to the following MS4s:

Lewisburg (TNS077615)
Manchester (TNS088331)
Rutherford County (TNS075647)
Shelbyville (TNS075531)
Tullahoma (TNS077631)
Williamson County (TNS075795)
Tennessee Dept. of Transportation (TNS077585)

- 6) Letters were sent via email to water quality partners in the Upper Duck River watershed advising them of the proposed E. coli TMDLs and their availability on the TDEC website and providing a link to a downloadable version of the TMDL document. The letters also stated that a written copy of the draft TMDL document would be provided upon request. Letters were sent to the following partners:

Natural Resources Conservation Service
Tennessee Duck River Development Agency
Tennessee Department of Agriculture
Tennessee Valley Authority
Tennessee Wildlife Resources Agency
The Nature Conservancy

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